

## **ACRONYMS AND ABBREVIATIONS**

AGL - Above Ground Level  
AP - Anomalous Propagation  
ARL -Above Radar Level  
AVSET - Automated Volume Scan Evaluation and Termination  
AWIPS - Advanced Weather Interactive Processing System  
BE – Book End as in Book End Vortex  
BWER - Bounded Weak Echo Region  
CAPE - Conditional Available Potential Energy  
CIN – Convective Inhibition  
CC – Correlation Coefficient Dual Pol Product  
CR -Composite Reflectivity Product  
CWA -County Warning Area  
DP – Dual Pol  
dBZ - Radar Reflectivity Factor  
DCAPE - Downdraft Conditional Available Potential Energy  
DCZ - Deep Convergence Zone  
EL – Equilibrium Level  
ET -Echo Tops Product  
ETC - Extratropical Cyclone  
FAR - False Alarm Ratio  
FFD – Forward Flank Downdraft  
FFG – Flash Flood Guidance  
GTG – Gate-To-Gate  
HP - High Precipitation supercell (storm)  
HDA -Hail Detection Algorithm  
LCL -Lifting Condensation Level  
LEWP -Line Echo Wave Pattern  
LP - Low Precipitation Supercell (storm)  
MARC - Mid Altitude Radial Convergence  
MCC - Mesoscale Convective Complex  
MCS - Mesoscale Convective System  
MCV – Mesoscale Convective Vortex  
MESO -Mesocyclone  
MEHS -Maximum Expected Hail Size  
OHP -One-Hour Rainfall Accumulation Product  
POSH -Probability of Severe Hail  
QLCS - Quasi Linear Convective Systems  
R - Rainfall Rate in Z-R relationship  
RF – Range Folding  
RFD - Rear Flank Downdraft

RIJ - Rear Inflow Jet  
RIN – Rear Inflow Notch  
SAILS - Supplemental Adaptive Intra-Volume Low-Level Scan  
SCP – Supercell Composite Parameter  
SRH – Storm Relative Helicity  
SRM -Storm Relative Mean Radial Velocity  
STP –Significant Tornado Parameter  
STD – Storm Top Divergence  
TBSS -Three-Body Scatter Spike  
TDA -Tornado Detection Algorithm  
TDS – Tornado Debris Signature  
TDWR -Terminal Doppler Weather Radar  
THP -Three-Hour Rainfall Accumulation Product  
TVS - Tornadic Vortex Signature (in velocity data) and in the WSR -88D Product  
V – Radial Velocity data  
VCP - Volume Coverage Pattern  
VIL - Vertically Integrated Liquid Product  
VWP - Velocity Azimuth Display Wind Profile Product  
VR – Rotational Velocity  
W - Spectrum Width Data  
WER - Weak Echo Region  
WSR-88D - Weather Surveillance Radar - 1988 Doppler  
Z - Radar Reflectivity Data  
ZDR – Differential Reflectivity Dual Pol Product  
ZR – Reflectivity/Rainfall Rate Relationship

## GLOSSARY

**Anomalous Propagation (AP):** When non-standard index-of-refraction distributions prevail, “abnormal” or “anomalous” propagation occurs. When abnormal downward bending occurs, it is called “superrefraction.” The term “subrefraction” is applied when there is abnormal upward bending.

**Attenuation:** Any process in which the flux density (power) of a beam of energy is dissipated.

**Automated Volume Scan Evaluation and Termination (AVSET):** An algorithm that terminates a radar volume scan after the WSR-88D has scanned all of the elevations with significant reflectivity returns.

**Base Data:** Reflectivity, mean radial velocity, and spectrum width data.

**Book-End Vortices:** (Also called “line-end vortices.”) With time, MCSs tend to develop vortex pairs with opposite sense rotation at the ends of the convective line.

**Bounded Weak Echo Region (BWER):** A core of weak reflectivity in a thunderstorm that identifies the location of an intense updraft. The updraft is so strong that large precipitation particles do not have time to form in the lower and mid-levels of the storm and are prevented from falling back into the updraft core from above.

**Bow Echo:** A bow-shaped line of convective cells that is often associated with swaths of damaging straight-line winds and short-lived tornadoes. Key structural features include an intense rear inflow jet impinging on the core of the bow, with bookend or line-end vortices on both sides of the rear-inflow jet, behind the ends of the bowed convective segment.

**Bright Band:** The enhanced radar echo caused by the difference in radar reflectivity of ice and water particles. This echo is interpreted as the delineation on a radar display between frozen and liquid precipitation.

**Cap:** (*as in capping inversion*) A layer of relatively warm air aloft (usually several thousand feet above the ground) which suppresses or delays the development of thunderstorms.

**Centroid:** The center of mass of a storm.

**Clutter:** Echoes that interfere with observations of desired signals on a radar display. Usually applied to ground targets.

**Comma Head:** (Sometimes known as “rotating comma head.”) The northern, rounded portion of a convective line of storms called a bow echo and often associated with a mesocyclone or mesovortex.

**Convective Available Potential Energy (CAPE):** A measure of instability. The maximum energy available to an ascending parcel, according to parcel theory. On a thermodynamic diagram this is called positive area, and can be seen as the region between the lifted parcel process curve and the environmental sounding, from the parcel's level of free convection to its level of neutral buoyancy.

**Convective Inhibition (CIN):** A measure of the amount of energy needed in order to initiate convection reflecting the strength of the cap.

**Couplet:** Adjacent maxima of radial velocities of opposite signs.

**Cyclic:** As in cyclic storm; a thunderstorm that undergoes cycles of intensification and weakening (pulses) while maintaining its individuality. Cyclic supercells are capable of producing multiple tornadoes (i.e., a tornado family) and/or several bursts of severe weather.

**Dealiasing:** Process of correcting for aliases in the velocity measurement.

**Debris Ball:** An area of high radar reflectivity, typically located within a hook or appendage, caused by large debris being lofted into the air and usually associated with a tornado or tornado vortex signature.

**Deep Convergence Zone (DCZ):** A narrow and deep velocity signature characterized by strong convergence along a nearly vertical interface extending from the radar horizon upward to altitudes as high as 50,000 ft. often associated with very damaging surface winds and related to the Mid Altitude Radial Convergence.

**Delta-V:** The quantity of maximum inbound and outbound radial velocity ( $V_{in} + V_{out}$ ); a measure of the strength of convergence, divergence, or rotation.

**Derecho:** A widespread convectively induced straight-line windstorm event. Specifically, the term is defined as any family of downburst event clusters produced by an extratropical mesoscale convective system. Derechos may or may not be accompanied by tornadoes.

**Downburst:** A strong downdraft that induces an outburst of damaging winds on or near the ground.

**Downdraft:** Current(s) of air with marked vertical downward motion.

**Downdraft Convective Available Potential Energy (DCAPE):** Downdraft CAPE. DCAPE can be used to estimate the potential strength of rain-cooled downdrafts with thunderstorms, and is similar to CAPE. Larger DCAPE values are associated with stronger downdrafts.

**Dual-Polarization Radar:** A radar capable of transmitting and receiving two orthogonal polarizations.

**Dual Polarization Variables:** The three radar variables (Differential Reflectivity, Correlation Coefficient, and Differential Phase) derived by comparing the attributes of the returned Horizontal and Vertical pulses.

**Ducting:** The phenomenon by which the radar signal propagates along the boundary of two dissimilar air masses. Ducting occurs when the upper air is exceptionally warm and dry in comparison with the air at the surface.

**Echoes:** Areas of radar reflectivity visible in the WSR-88D products that may represent meteorological or non-meteorological phenomena.

**Echo Tops:** The height of the greatest (in altitude) non-zero reflectivity above the surface of the Earth.

**Echo Training:** Thunderstorm (or shower) cells following one after another over the same location.

**Elevation Angle:** The angle of the radar beam. This value varies from 0.5° to + 19.5° on the WSR-88D.

**Elevation Scan:** The process of the radar completing a full 360° rotation in azimuth for a specific elevation angle.

**Equilibrium Level (EL):** The level above the level of free convection (LFC) at which the temperature of a rising air parcel again equals the temperature of the environment.

**Forward Flank Downdraft (FFD):** The main region of downdraft in the forward, or leading, part of a supercell, where most of the heavy precipitation (rain, hail) is located.

**Gate-to-Gate (GTG):** A term used to describe when the maximum inbound and maximum outbound radar velocity is immediately adjacent to each other (side by side).

**Ground Clutter:** The pattern of radar echoes from fixed ground targets.

**Gust Front:** The boundary or leading edge of the downdraft (propagating cold air outflow) from a thunderstorm.

**Helicity:** One-half the scalar product of the velocity and vorticity vectors. The concept is useful in understanding severe convective storms and tornadoes, since in strong updrafts the velocity and vorticity vectors tend to be aligned, yielding high helicity.

**Hook Echo:** A pendant or hook on the right side of a radar reflectivity echo that often identifies mesocyclones on the radar display. The hook is caused by precipitation drawn into a cyclonic spiral by the winds, and the associated notch in the echo is caused by precipitation-free, warm, moist air flowing into the storm.

**Isodop:** Contour of constant Doppler velocity values.

**Isolated Storm:** An individual cell or group of cells that are identifiable and separate from other cells in a given geographic area.

**Lapse Rate:** The decrease of an atmospheric variable with height, the variable being temperature, unless otherwise specified.

**Lifting Condensation Level (LCL):** The level at which a parcel of moist air lifted dry-adiabatically would become saturated.

**Line Echo Wave Pattern (LEWP):** A special configuration in a line of convective storms configured like a wave which may indicate the presence of a low pressure area and the possibility of damaging winds and tornadoes. In response to very strong outflow winds behind it, a portion of the line may bulge outward forming a bow echo.

**Low-topped Supercells:** A convective storm that contains similar radar characteristics to those of a supercell (e.g., mesocyclone, hook echo, WER, BWER), but is significantly smaller in height.

**Macrobust:** Large downburst with 4 km (2.2 nmi) or larger outflow size with damaging wind lasting 5 to 20 minutes.

**Maximum Expected Hail Size (MEHS):** A radar algorithm that computes the maximum expected hail size. MESH usually overestimates the maximum size of hail that will reach the earth's surface. MESH is designed such that approximately 75% of hail will be smaller than the MESH.

**Mean Doppler Velocity:** Reflectivity-weighted average velocity of targets in a given volume sample. Also called mean radial velocity

**Mesocyclone or Mesovortex (meso):** A 3-dimensional storm scale region of cyclonic rotation in a storm and is closely correlated with severe weather.

**Mesoscale:** Pertaining to atmospheric phenomena having horizontal scales ranging from a few to several hundred kilometers, including thunderstorms, squall lines, fronts, precipitation bands.

**Mesoscale Convective Complex (MCC):** A subset of mesoscale convective systems (MCS) that exhibit a large, circular (as observed by satellite), long-lived, cold cloud shield having a cloud-top area larger than 100,000 km<sup>2</sup> (29,000 n mi<sup>2</sup>) and persisting for more than 6 hours.

**Mesoscale Convective System (MCS):** A cloud system that occurs in connection with an ensemble of thunderstorms and produces a contiguous precipitation area on the order of 100 km or more in horizontal scale in at least one direction.

**Mesoscale Convective Vortex (MCV):** A warm core mid-altitude mesoscale vortex often produced as an MCC or MCS decays; often associated with a recurrence of convection.

**Mean Radial Velocity:** The component of motion of the target toward or away from the radar.

**Microburst:** Small downburst, 1 to 4 km (0.54 to 2.2 nmi) in outflow size, with peak winds lasting 2 to 15 minutes.

**Mid-Altitude Radial Convergence Signature (MARC):** Persistent areas of radial convergence within mid-levels (~ 3 to 7 km AGL) and within the larger zone of convergence along the forward flank of the convective line or storm and appears to be linked to the greatest degree of wind damage. Similar to the Deep Convergence Zone but generally confined to the mid-levels.

**Mini-Supercell:** A convective storm that contains similar radar characteristics to those of a supercell (e.g., mesocyclone, hook echo, WER, BWER), but is significantly smaller in height and width.

**Overhang:** A storm has overhang if the edge of the storm component at a given height range (mid-levels) extends outward beyond the edge of the storm component at the lowest elevation by a specified distance.

**Probability of Severe Hail (POSH):** A radar algorithm that computes the probability that a cell will produce severe size hail.

**Pulse:** A single short duration transmission of electromagnetic energy.

**Pulse Severe Storm:** A convective storm characterized by a single, strong, updraft pulse producing a short-lived period of large hail or damaging winds at the surface; lifespan typically < 60 minutes.

**Quasi-linear Convective System (QLCS):** A linear configuration of organized thunderstorms such as a squall line or bow echo.

**Radial Velocity:** The component of motion of the target toward or away from the radar.

**Radome:** A dome used to cover the antenna assembly of a radar to protect it from the effects of weather.

**Range Folding (RF):** Range Folding is basically when the radar is unable to determine the wind's velocity. This is due to the speed at which the radar transmits signals, called the pulse repetition frequency (PRF). The faster the pulses are sent by the radar the less time it has to listen for any returned signals. It occurs when the return from a prior pulse is detected during the listening period for the current pulse. Both reflectivity and velocity data are affected by this. The occurrence of range folding can usually be detected by radar software and reflectivity data can be "unfolded" using special programs. However, velocity data cannot be accurately unfolded and therefore the effective range with which Doppler radars can detect velocity data is limited by the frequency of the radar pulses; the higher the pulse rate, the shorter the range within which the velocity field can be determined.

**Rear Flank Downdraft (RFD):** A downdraft almost exclusively associated with supercell storms found along the rear portion (facing in the direction of storm motion) of the storm and associated with the mesocyclone and often, tornadoes. Sometimes responsible for damaging surface winds.

**Rear Inflow Jet (RIJ):** A mesoscale circulation feature in which a system-relative current of air enters and flows through the stratiform precipitation region of an MCS from the rear. The rear inflow jet forms in response to the upshear-tilting of the convective circulation, as the horizontal buoyancy gradients along the back edge of the system create a circulation that draws mid-level air in from the rear. The rear inflow jet supplies potentially cold and dry mid-level air that aids in the production of convective and system-scale downdrafts.

**Rear Inflow Notch (RIN):** A channel of weak echo extending from the rear into a convective storm line. Often associated with the rear inflow jet.

**Reflectivity:** The measure of the efficiency of a target in intercepting and returning electromagnetic radar energy. With hydrometeors, it is a function of the drop size distribution, number of particles.

**Refraction:** Changes in the direction of energy propagation (due to changes in speed) as a result of density changes within the propagating medium.

**Rotational Velocity ( $V_r$ ):** A quantity used to evaluate the strength of rotation depicted in doppler radar velocity data;  $V_r = (V_{\max} + V_{\min})/2$  where  $V_{\max}$  is the maximum outbound velocity (+) and  $V_{\min}$  is the maximum inbound velocity (-).

**Scatterer:** Any object capable of reflecting the radar signal.

**Shear:** The rate of change of the vector wind in a specified direction normal to the wind direction. Vertical shear is the variation of the horizontal wind in the vertical direction.

**Shelf Cloud:** A type of arcus (or roll) cloud. It is a low-level horizontal accessory cloud that appears to be a wedge shape as it approaches as seen along the leading edge of approaching thunderstorms. It is accompanied by gusty straight-line winds and is followed by precipitation.

**Significant Tornado Parameter (STP):** A multiple ingredient, composite index that includes effective bulk wind difference (EBWD), effective storm-relative helicity (ESRH), 100 mb mean parcel CAPE (mCAPE), 100 mb mean parcel LCL height (mLCL), and 100 mb mean parcel CIN (mCIN). A majority of significant tornadoes (EF2/F2 or greater damage) have been associated with STP values greater than 1.

**Spearhead Echo:** A radar echo associated with a downburst with a pointed appendage extending toward the direction of the echo motion. The appendage moves much faster than the parent echo, which is drawn into the appendage. During the mature stage, the appendage turns into a major echo and the parent echo loses its identity.

**Spectrum Width:** A measure of dispersion of velocities within the radar sample volume.

**Squall Line:** A line of active thunderstorms, either continuous or with breaks, including contiguous precipitation areas resulting from the existence of the thunderstorms. The squall line is a type of mesoscale convective system distinguished from other types by a larger length-to-width ratio.

**Storm Relative Helicity (SRH):** A measure of the potential for cyclonic updraft rotation in right-moving supercells. Larger values of 0-3 km SRH ( $> 250 \text{ m}^2\text{s}^{-2}$ ) and 0-1 km SRH ( $> 100 \text{ m}^2\text{s}^{-2}$ ) suggest an increased threat of tornadoes with supercells and also QLCs.

**Storm Top Divergence (STD):** A measure of the divergence at the top of a thunderstorm, used to quantify updraft strength.

**Stratiform:** Descriptive of clouds or precipitation of extensive horizontal development, as contrasted to the vertically developed convective clouds or precipitation types.

**Supercell:** An often dangerous convective storm that contains radar characteristics such as the hook echo, WER, and BWER but also contains a deep, persistent mesocyclone characterized most often by cyclonic vorticity and closely associated with the dominant storm updraft and RFD. Variations include the "Low Precipitation" (LP), Classic, and "High Precipitation" (HP) Supercells.

**Supercell Composite Parameter (SCP):** A multiple ingredient, composite index that includes effective storm-relative helicity (ESRH, based on Bunkers right supercell motion), most unstable parcel CAPE (muCAPE), and effective bulk wind difference (EBWD). Each ingredient is normalized to supercell "threshold" values, and larger values of SCP denote greater "overlap" in the three supercell ingredients. Only positive values of SCP are displayed, which correspond to environments favoring right-moving (cyclonic) supercells.

**Supplemental Adaptive Intra-Volume Low-Level Scan (SAILS):** A dynamic scanning technique that inserts a new low-level split cut scan into severe weather VCPs 12 and 212. The effect of this scanning technique is to decrease the time interval between lowest angle split cut scans by half.

**Three-body Scatter Spike (TBSS):** (Also called a "flare echo.") A long, narrow, weak reflectivity echo artifact sometimes found extending down radial from highly reflective echo cores. Indicative of large hail and caused by forward Mie scattering or radar signals, reflecting from the hail core, to the ground, back to the hail core, and back to the radar.

**Tilt:** A storm is said to have tilt if a line connecting the centroid of a mid-level storm component to the centroid of the lowest storm component is to the right or rear of the direction of movement of the storm.

**Tornado Debris Signature (TDS):** Sometimes also referred to as Dual Pol TDS (DPTDS), the co-location of low correlation coefficient (CC) values < 0.8; low differential reflectivity (ZDR) values < 0.5 dB; high reflectivity values >45 dBz, and a strong doppler velocity couplet in dual polarization radar data.

**Tornado Vortex Signature (TVS):** The Doppler velocity signature of a vortex that is indicative of a tornado or tornadic circulation, which is a gate-to-gate velocity couplet within a mesovortex observed at close range, generally within 54nm.

**VAD Wind Profiler (VWP):** A time-height display of horizontal winds above a doppler radar, derived from WSR-88D data. It depicts the change in wind with time at various heights. This display is useful for observing local changes in vertical wind shear, such as backing of low-level winds, increases in speed shear, and development or evolution of nearby jet streams (including low-level jets).

**Velocity Aliasing:** Ambiguous detection of radial velocities outside the Nyquist co-interval.

**Vertically Integrated Liquid (VIL):** A parameter that takes into account the three dimensional reflectivity of an echo. The maximum VIL of a storm is useful in determining its potential severity, especially in terms of maximum hail size.

**Volume Coverage Pattern:** The automatic radar scanning sequence control as it scans the atmospheric volume (from the surface to 70,000 ft and from the radar to 248 nm radius) surrounding the radar.

**Vortex:** A region of rotation similar to a mesocyclone that possesses vorticity.

**Vorticity:** A vector measure of local rotation in a fluid flow.

**Wall Cloud:** A local, abrupt lowering of a rain-free cumulonimbus base into a low-hanging accessory cloud and typically signifies the base of the thunderstorm updraft. The wall cloud is usually located in the southwestern part of a severe thunderstorm to the southwest of the main precipitation region. Rapid upward motion and visible rotation may be seen in wall clouds from several km away.

**Weak Echo Region (WER):** A region of weak radar echo that is bounded on one side and above by strong echo. It is located on the low-altitude inflow side of the storm and is produced by a strong updraft.

**Wind Shear:** The local variation of the wind in a given direction (horizontal and vertical).